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INVITED COMMENTARY

Training on Simulators: Limitations and Relevance

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Currently, apprenticeship training of interventional skills occurs in a curriculum[1] which teaches essential knowledge and rules, and develops the behaviour and attitudes of professionalism. The core skills to guide wires and catheters using touch and imaging are practiced until automated, to avoid exceeding the learner's attentional capacity when performing more complex tasks in patients.[2,3] Once acquired, skills are maintained by regular practice, or may need to be refreshed by re-training. The authors of '*Identification of skills common to renal and iliac endovascular procedures performed on a virtual reality simulator*' note the risks, and the reducing opportunities, for this basic training.[4–7] There is therefore a pressing need to implement an alternative to patient centred learning, as well as to introduce precisely and accurately defined minimum standards for success. Suitable alternatives to training in patients include various simulations such as models, animals, standardised patients (using actors) and computer based simulation. The latter has the potential to allow an operator to realistically perform a virtual procedure with feedback on performance, and could remove at least some of the patient's role during the learning curve.

There has been successful demonstration of clinical benefit using computer based simulator models to train laparoscopy, colonoscopy and anaesthetics, though this has yet to be reproduced for interventional vascular simulations.[8–15] While contemporary endovascular simulators appear suitable for learning the correct sequence of procedural steps and selection of appropriate tools (many medical errors result from incorrect procedural sequencing), their use to train catheter manipulation skills that are applicable to real world procedures remains unproven.[15] It is therefore of interest that Neequaye *et al*. have investigated the utility of the Mentice VIST-VR to train, assess and identify core skills within the virtual environment of a simulator model. The authors have shown operator skills common to both iliac and renal simulations, and claim that this demonstrates 'transference of skills'. They have also deduced the existence of (a) separate core skill(s) for renal cannulation in the simulation. From these findings it is further concluded that novices may not need to complete all available simulation modules, though it would be important to first identify from the curriculum, which performance objectives actually need to be met using simulator training.

Simulation is widely considered an important future tool in interventional vascular skills training. The authors believe that this is now supported by the findings of their study, and that surgeons can improve their skills using VR based simulation, though this has not, in this publication, been corroborated by benchmarking against real world performance. There are a number of fundamental studies which can be used to inform the validity of simulation for high stakes, skills training. Content validity is of particular importance in claiming relevance of a simulation to the real world task in a curriculum.[16] For content validity, subject experts are required to verify that for training, the simulation accurately replicates the procedure or process it claims to model, and for assessment, that a test measures what it is supposed to measure. For face validity, the simulation must appear to test takers to resemble the real world task: to attain face and content validity, the simulation must clearly provide an appropriate level of fidelity. Concurrent validity correlates the test with a gold standard, with real

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world performance as a benchmark. Construct validity evaluates whether the simulator assesses factors that are important to acquisition of the required skills: the measures (metrics) used should therefore be relevant to the objectives of the training curriculum.

For integration into curricula, face and content validity are particularly important but the use of simulation for assessment requires at least face, construct and content validity. Once this has been shown, it becomes more likely that skills trained in the simulation will transfer to the conditions of real world procedures in patients: this specific benchmark is known as 'transfer of training' (or skills transfer). Hence while the authors have identified some skills which appear to be common to different modules of a simulation, the description of this as 'transfer of skills' seems inappropriate and open to misinterpretation. In any event, and as intimated by the authors themselves, the fundamental relevance of these observations made in a simulator to real world interventional performance, remains unclear.

For an assessment (including simulator based assessment) to provide legitimate evidence for award of a certification by a statutory body, content should follow the discipline's curriculum.[17] When considering the use of a particular simulator, it is therefore important to know how and by whom the test items and metrics were developed, the relevance of these metrics to the curriculum's training objectives, and whether they can indeed be tested by the simulator. The assessments provided in current endovascular simulators are of high level performance, such as the time taken to 'successfully' perform a procedure, fluoroscopy time, 'C' arm handling or contrast volume used. The authors draw attention to the surrogate nature of these metrics, which provide little indication of real proficiency; more discriminatory, lower level metrics are however absent from the simulation, though these could assess more relevant, manipulative skills. This might reflect a lack of subject matter expert input, or simply that these are the only metrics that can currently be utilised by a particular simulation.

The skills (including automated behaviours) required to perform real world tasks such as renal artery catheterisation can be objectively identified by trained psychologists, with grading of key performance indicators by subject experts.[18] These metrics may be used for observer-based assessment of procedures in patients, or assimilated into the development phase of simulators to automatically (and therefore objectively) assess proficiency. Computer based assessments can also test for technical or cognitive errors, though the authors acknowledge the limited value of their data obtained on cognitive errors in procedural sequencing in the presence of a checklist.

The authors identify the importance of unravelling the nature of skills, and the level of fidelity required. At the same time the discussion implies that in some way training objectives differ between specialities (*simulators have been proposed…in vascular surgery… however a great deal of work…on…validation of interventional radiology…simulations…must be completed…*). Yet the need for an appropriate training environment, for key training objectives to be met, and for trained skills to transfer to real world tasks in patients is inescapable, whether surgeon, radiologist, cardiologist or any other practitioner. This requires an appropriate level of sensory fidelity, content that mirrors the real world task, and evidence-based metrics that test technical skills. Thus equipped, computer based simulation should train and assess actual skills required in renal and iliac interventions, without risk of training inappropriate or incorrect skills (negative training) and with greater likelihood of successful, clinical validation.

The potential exists to move skills training in patients to 'training in silico' in a range of case scenarios, including critical events, with feedback providing essential information for the trainee's development.[19,20] Yet it has not been possible to find the real world relevance to support some of the authors' claims, amongst the data presented. These could have included benchmarking against real world expert performance, and identification of the training objectives which might be met by current generation simulator models. This is work that the authors should consider for the future.

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